Recording path-time diagrams of linear motions (P 1.3.1.1)

P 1.3.1

One-dimensional motions on the track for students' experiments

P1.3.1.1 Recording path-time diagrams of linear motions

Cat. No.	Description	P 1.3.1.1
588 813S	STM equipment set Mechanics 3 (MEC 3)	1
521 210	Transformer, 6 V AC, 12 V AC/ 30 W	1
309 48	Cord, 10 m	1

The motion of Fletcher's trolley on a track is recorded using a strip of paper which the trolley pulls through a recorder. The device marks the respective position on the measurement tape at fixed intervals (e.g. $\Delta t = 0.1$ s).

The experiment first investigates uniform motions of the trolley. The marked positions on the register tape are measured and entered in a path-time diagram as value pairs (s_i, t_i). From the diagram, it is possible to recognize the linear function

$s = v \cdot t$
v: average velocity

In the further evaluation, the paper register tape is cut at the position marks and the sections are placed side by side in a row. Their lengths correspond to the instantaneous velocities

$$v_i = \frac{1}{\Delta t} \cdot (s_{i+1} - s_i),$$

which agree with the average velocity v within the context of the measuring accuracy.

Uniformly accelerated motion of the trolley on the inclined track is subsequently evaluated in the same way. Additionally, the instantaneous velocities v_i are plotted in a velocity-time diagram as value pairs (v_i, t_i). Unlike uniform motions, the lengths of the tape strips, or the instantaneous velocity, increase for equal time intervals. The increase in length, and thus the instantaneous acceleration

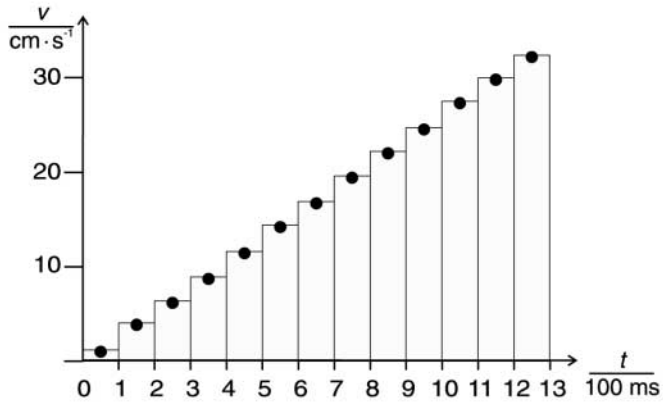
$$a_i = \frac{1}{\Delta t} (v_{i+1} - v_i),$$

is constant within the attainable measuring accuracy. From the velocity-time diagram, we can recognize the linear function

$v = a \cdot t$
a: average acceleration

and from the path-time diagram the function

$$s = \frac{1}{2} a \cdot t^2.$$



Velocity-time diagram of a uniformly accelerated motion